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ABSTRACT

This experimental study examined the effects of multimedia on Internet news readers, in particular focusing on Web site design and its effect on comprehension and recall of news stories. Subjects (84 undergraduate students) viewed one of two versions of the same Web site--one with multimedia and one without. The Web site consisted of six stories not heavily covered in the media from the categories of local news, national news (politics), international news, sports, health and human interest (people). Text and images on both sites were identical, except that on the plain site audio and/or video enhancements of the multimedia site were transcribed and placed in the same location in the story as on the multimedia site. This made it possible to determine the influence on comprehension and recall of the presence or absence of the audio and/or video files. Dependent variables were comprehension, recall, or response to site. A post-test measured comprehension and recall. Findings did not support a significant difference in comprehension, recall, or response arising from presence or absence of multimedia. Comprehension and recall with regard to items such as current events knowledge, gender, and advertisements are also discussed. Short discussions of information gathered on other factors (time of day, style of writing, interest, sex of the subject, stories read first and last, and number of advertisements remembered from each site) are also presented. Contains 41 references and 7 tables of data. (SR)

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# Comprehension and Recall of Internet News: A Quantitative Study of Web Page Design

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CS 510 129

## ABSTRACT

**Comprehension and Recall of Internet News: A Quantitative Study of Web Page Design**

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This experimental study examined the effects of multimedia on Internet news readers. Subjects viewed one of two versions of the same Web site—one with multimedia and one without. Dependent variables were comprehension, recall, and response to site. Findings did not support a significant difference in comprehension, recall, or response arising from presence or absence of multimedia. Comprehension and recall with regard to items such as current events knowledge, gender, and advertisements are also discussed.

Jung-Sook Lee Award Winner

# Comprehension and Recall of Internet News: A Quantitative Study of Web Page Design

## Introduction

Broadcast and print media have long been the only sources of news for the consumer; however, in the past five years, news organizations have moved on-line, to the Internet, developing Web sites at an amazingly rapid rate. The result of this rapid evolution is a powerful new medium that has the potential to provide readers with information at a speed and extent not possible in the traditional form. Where traditional papers are "bound by the rising costs of newsprint" (Henderson & Fernback, 1998, p. 115), the space for Internet news is virtually unlimited.

As of July 10, 1998, the database for *Editor and Publisher Online* offered links to 3,679 magazines, 3,014 newspapers, 1,925 radio sites, 136 syndicated news services and 1,242 television sites (1998), and 36 million users (20% of Americans) are reported as getting news from the Internet at least once a week (Event-driven news audiences: Internet news takes off, 1998). The majority falls in the categories white, male, 18- to 29-year-olds, college graduates and households with incomes over $50,000 annually (Event-driven news audiences: Internet news takes off, 1998). Nearly every major news organization from print to broadcast now has a related Web site. Print publications typically produce Web sites that contain the same stories as the print version, placed in a very basic Web design that is easy to navigate. For example, the *New York Times* and *USA Today* both consist of a main page that contains a picture of the print version's flag, headlines typed in the same font and point size as in the print version that are linked to stories, which are simply copied, pictures and all, and reformatted in HTML and published on the Web. Television and radio sites may also have audio or video files to accompany a presentation of the principal stories or transcripts of the broadcast news program or show, but for the most part, they too exhibit a very print-oriented design. For example, the Web sites for CNN, NPR and MSNBC

(NBC news) all contain links to the main news topics (e.g., news, business, sports, etc.) and to news programs regularly appearing on these networks; but when the links to these shows and their stories are followed, what one finds are full-text stories or transcripts with photo enhancements that look very much like a traditional newspaper or newsmagazine. Audio and video may be included with these stories, or there may be links to pages consisting entirely of audio and video files with separate reports on the same stories. Items not found in the traditional medium that may be included on these sites range from reporter biographies and programming guides to contact information via e-mail.

While these designs are traditional in that their physical appearance resembles a typical newspaper or newsmagazine, the addition of video and audio files to text-based stories that viewers can access on demand and go back to as many times as they wish is revolutionary and creates the potential for completely new methods of news delivery combining print with broadcast—two media often considered at odds with one another. Sites usually offer links to archival information, "chat" rooms for viewers to respond to either site content or regular programming and surveys or other interactive devices that attempt to create a sense of community or involvement with the news organization. Such enhancements are intended to bring the audience closer to the news source and provide an interesting, though not entirely reliable, gauge of public opinion. In view of this Internet revolution, it becomes important to study the effects on the audience of multimedia enhancements, such as the addition of audio or video files to traditional, print-based stories.

This study examines comprehension and recall for Web sites that exhibit traditional print-based design without multimedia compared with Web sites that incorporate multimedia enhancements. It examines the benefit of using audio and video with text to convey messages effectively and attempts to give insight to the optimum method of news delivery via the Internet.

## Review of the Literature

The body of research on Web site design and its relation to comprehension and recall is quite small. In collecting information upon which to base this study, therefore, it was necessary to consult studies that focused on comprehension and recall for traditional print and broadcast sources. The literature was organized into studies that focused on the advantages of using a print or a broadcast source and the problems with broadcast news in general; studies that critiqued past research on comprehension and recall of news; studies that focused on cognitive processing and elements of story structure that increase the processing of news stories; and studies concentrating on problems in sending and receiving messages as these problems relate to news stories.

### Reading the News

Studies of audience recall and comprehension for news stories have not provided encouraging findings for the press. As a general rule, comprehension and recall scores for news presented in any medium are not very high (Bernard & Coldevin, 1985; DeFleur & Cronin, 1991; Gunter, Furnham, & Gietson, 1984; Hyatt, Riley, & Sederstrom, 1978; Saljo & Cedersund, 1988). The body of research seems to agree, however, that as a general rule, recall and comprehension are higher for news received from a print source than from any other medium (DeFleur et al., 1992).

Studies focusing on reading comprehension alone have shown that differences between print and computer screen reading tests are not significant (Barber, 1988; DeFleur et al., 1992). Facts presented in print and on computer screen have also been shown to promote a significantly higher level of comprehension and recall than facts from the same stories presented on radio or television (DeFleur & Cronin, 1991). For this reason, studies of comprehension and recall for news appearing in print can be generalized to studies of comprehension and recall for Internet news in formulating hypotheses.

The advantages of print news are varied. Studies have suggested improved recall for print news is due to the fact that readers can pace themselves while going through printed stories, as opposed to broadcast media where the information is presented quickly and must be processed immediately (Gunter, Furnham, & Gietson, 1984; DeFleur et al., 1992). Studies have also suggested comprehension is improved because of the level of attention paid to print reports as compared to broadcast (Browne, 1978; DeFleur et al., 1992). Comprehension is directly correlated with looking (Anderson & Burns, 1991; Kardes, 1993), and print presentations require active looking, or reading, for information to be received. Broadcast news, by contrast, often suffers from "contextual interference," or interference as a result of the viewer engaging in other activities while the message is being sent (Anderson & Burns, 1991; DeFleur et al., 1992; Woodall, Davis, & Sahin, 1983). Finally, studies have suggested print promotes better recall because it requires the reader to imagine his or her own visuals, which requires more cognitive processing of information, as opposed to broadcast where the necessary images are provided (Gunter, Furnham, & Gietson, 1984).

Watching the News

Although most Web news sites demonstrate a print-oriented design, with improvements in technology, more are incorporating elements of broadcast media as well. These elements take the form of audio and video files, animated graphics and moving text, and full-color Web sites as opposed to print's traditional black-on-white.

Studies of broadcast media have consistently shown broadcasting's inferiority to print in promoting recall and comprehension. Reasons given for the inferiority of broadcast news, whether by television or radio, have interesting implications for Web news because of the technological similarities between the two. Neil Postman, in his book *Amusing Ourselves to Death*, criticizes television news for reducing social and political discourse to the level of entertainment (1985).

Many researchers have pointed to this characteristic of television news as one of the main hindrances in its ability to make a lasting impression on the viewer. Studies have suggested that because broadcast news is brief and entertaining, it is cognitively processed at a lower level than print news, which could account for the reason it is recalled at a significantly lower level (Lang, 1989; Wicks, 1992). Other researchers have suggested the problem is that broadcast news cannot be studied in the same manner as print news (DeFleur et al., 1992; Gunter, Furnham, & Gietson, 1984). The high scores of subjects given free-recall tests after treatment with a print source are attributed to the different cognitive processes used when receiving messages from a print source as opposed to a broadcast source (Bennett, Swenson, & Wilkinson, 1992; DeFleur et al., 1992; Gunter, Furnham, & Gietson, 1984). Broadcast news is presented quickly and with little repetition. This precludes the viewer's ability to focus on items that may require more cognitive processing and excludes viewers who may lack initiation with the news story or who may be involved in other activities while the broadcast is taking place (DeFleur & Cronin, 1991; Lang, 1989; Wicks, 1992).

For this reason, more recent studies have focused on the broadcast source, hoping to find ways to improve presentation and thereby increase comprehension and recall. These studies have shown viewers exhibit better retention for broadcast items that use highly visual information when the visual content is closely related to the material being spoken than for items that use the "talking head" scenario (Brosius, Donsbach, & Birk, 1996; Edwardson, Kent, Engstrom, & Hofmann, 1992). Studies also have shown that when highly redundant graphic presentations are used with verbal presentations, recall is significantly improved (Griffin & Stevenson, 1996). Reasons for this improvement have been attributed to incorporating "multiple channels" of processing information or presenting the same information or explanatory information using a different method of delivery (Berry, 1983; Booth, 1970-71). Finally, as is the case with print news, studies have shown that the level of attention paid to the broadcast is directly related to the amount of

information recalled. Saljo and Cedersund found that retention of broadcast news was "quite accurate, up to 73.9%, when there was strong reason to assume the viewers had paid attention [to the broadcast]" (1988, p. 450).

Critiques of broadcast media research have indicated that past studies incorporated inaccurate measures to examine the way information is coded and later retrieved from broadcast sources (Berry, 1983; Findahl & Höijer, 1985; Woodall, Davis, & Sahin, 1983). For example, some researchers have suggested the use of free-recall tests is invalid when used with broadcast media as it does not give viewers the necessary prompts to access information that may be stored in memory (Findahl & Höijer, 1985; Woodall, Davis, & Sahin, 1983). Other researchers have pointed out that the telephone survey method traditionally used to measure television news recall does not guarantee the individuals surveyed were actually paying attention to the broadcast in question (DeFleur et al., 1992; Saljo & Cedersund, 1988). These critiques have stated the need to focus on "viewer variables" as well as presentation variables. These studies contend that print is not necessarily superior to broadcast; rather researchers have failed to take into account the influence of the viewer, or how he or she affects the communication process, when studying the two media. Since communication involves a message that is sent by one source and received by another, defenders of broadcast media stress the need to focus on the breakdown taking place on the receiving end, or to study the "listener's contribution," as well as the changes that can be made in the source (Saljo & Cedersund, 1988; Lang, 1989).

## Viewer Variables

Viewer variables, or variables that arise from the viewer and that may influence comprehension and recall of the message, include interest in the subject matter (Berry, 1988), amount of general news knowledge (Woodall, Davis, & Sahin, 1983; Price & Zaller, 1993; Findahl & Höijer, 1985), educational level (Findahl & Höijer, 1985), gender (Findahl & Höijer,

1985; Gunter, Furnham, & Gietson, 1984) and even the time of day one watches or reads the news (Gunter, Jarrett, & Furnham, 1983). General media knowledge and interest are closely related to each other and usually act together to determine the amount of attention a specific stimulus will receive.

The increased level of comprehension and recall of news stories produced by general news knowledge can be explained as a result of expanded access to knowledge stored in the individual's memory (i.e., the semantic memory network) and an increased likelihood the new information will find a link to this existing knowledge. Researchers have shown that general news knowledge is not a function of educational level; rather, the more current events knowledge possessed by the individual, the greater the comprehension and recall of future news (Berry, 1983; Findahl & Höijer, 1985; Griffin & Stevenson, 1996; Price & Zaller, 1993; Woodall, Davis, & Sahin, 1983). It has, however, been suggested that higher educational levels foster greater news comprehension because of the subject's prior conditioning to attend to messages and acquire meaning from them (Price & Zaller, 1993). It has also been shown that viewers are less likely to pay attention to broadcast news that requires background information or "initiation" with the story (Berry, 1988; Findahl & Höijer, 1985; Lang, 1989; Larsen, 1988; Woodall, Davis, & Sahin, 1983). Viewers, instead, choose to focus on stories of which they have at least some prior knowledge. This selection process is often guided by interest.

Several studies have focused on the importance of interest in remembering the news. Interest can be aroused by the presentation of a story, or by any number of individual experiences stored in the subject's memory. Interest in stories, as it applies to the extent to which the subject can relate to the events being reported, is accepted as perhaps the strongest contributor to the recall and comprehension of news stories in all media (Berry, 1988; Booth, 1970-71; Findahl & Höijer, 1985; Saljo & Cedersund, 1988; Scott & Goff, 1988; Woodall, Davis, & Sahin, 1983). Interest aroused through empathy leads to deeper levels of cognitive processing and, therefore, improved

comprehension and recall. Interest can correlate to general knowledge, which, as previously discussed, has been shown to increase viewer recollection of the news, but prior interest is not a guarantee of increased comprehension or recall. Research has shown that interest aroused by method of presentation is more likely to increase comprehension and recall than a subject's existing interest in a topic alone (Berry, 1988); and it has been suggested that as an individual's interest is aroused by a particular news item, he or she will "actively select" that particular item or topic to focus on in future news stories (Berry, 1983; Findahl & Höijer, 1985; Griffin & Stevenson, 1996; Price & Zaller, 1993; Saljo & Cedersund, 1988). Interest in a topic such as health, for example, will not automatically imply higher comprehension and recall for a story on meningitis if the subject has no particular knowledge with regard to the condition or if the story is not presented in such a way as to arouse the subject's empathy. Level of interest also determines level of attention paid to a particular item, and as stated before, higher levels of attention are directly related to deeper levels of processing. It has been suggested that people do not even attempt to pay attention to or remember all items in a news program or paper, and, therefore, when studying comprehension and recall across news media, only items of interest to the subject should be evaluated (Saljo & Cedersund, 19 nterest, it is suggested, is the filter that determines what stories will be attended to, deeply processed, and later remembered.

The last two viewer variables to be considered are gender differences and time of day effects. It has been suggested by past research that males recall news stories at a significantly higher rate than females (Gunter, Furnham, & Gietson, 1984; Findahl & Höijer, 1985). One suggested reason is the idea that males in general are more likely to attend to news broadcasts than females (Gunter, Furnham, & Gietson, 1984). Recent studies on this issue, however, have shown that "the core audience for nightly network news is mainly older and female—55% of women over age 50" (Event-driven news audiences: Internet news takes off, 1998). Studies of episodic memory and recall have shown that females consistently outperform males in recall tests

measuring episodic memory (Herlitz, Nilsson, and Backman, 1997); however, studies focusing on semantic memory processing have not shown a significant difference in recall between males and females (Herlitz, Nilsson, and Backman, 1997). It is notable that in the 18 to 25 age group, males lead females in the use of on-line technology—a factor that could influence recall scores by gender (Event-driven news audiences: Internet news takes off, 1998).

Finally, time of day effects have been shown in several studies to influence comprehension and recall. Studies have consistently shown that information presented earlier in the day is more likely to be recalled than information that is presented later (Gunter, Jarrett, & Furnham, 1983). These studies have also shown that throughout the day, concrete information, or information about the who and the what of a story, is recalled at a consistently higher rate than abstract information, or causal information (Gunter, Jarrett, & Furnham, 1983). Concrete and abstract information will be explained more in the discussion of presentation variables.

Presentation Variables

Presentation variables, or variables that arise from the method of presentation and that may influence the viewer's or reader's ability to comprehend and recall the message, are controlled largely by story structure. Story structure consists of the type of information presented, the style of writing employed and the use of emotionally stimulating or neutral images. Item order has also been suggested as a factor influencing recall; however, studies of item order do not always agree on the significance of its effect.

The first element of story structure, type of information, is a function more of recall than comprehension. In the typical news story, two distinct classes of information are presented. Concrete information, which takes into account the who, what, when and where of events and which is easily visualized by the receiver, and abstract information, which involves the causes and consequences, or the how and the why of the story (Findahl & Höijer, 1985; Gunter, Furnham, &

Gietson, 1984; Woodall, Davis, & Sahin, 1983). The latter information is considered abstract because it is made up of words that cannot be easily visualized (e.g., justice, terrorism, poverty, etc.) and, therefore, cannot be processed as deeply. Researchers have found that for this reason subjects more easily recall concrete details (e.g., a 42-year-old white male, the White House lawn, a brown Oldsmobile, etc.) because subjects can form clear pictures of these details in their minds. Concrete events, along with the other viewer variables such as interest and prior knowledge, are processed at a deeper level because they draw on an existing network of information.

The second element of story structure, writing style, can take one of two forms: the narrative style or the inverted pyramid style, which is the standard writing style for news. Thomas J. Housel states that "schema theorists from cognitive psychology and linguistics have found that news readers comprehend, recall and are more aroused by stories written in the narrative structure than by stories written in the typical news structure" (1984, p. 505). Housel's study focuses on linguistic complexity in broadcast news, but the story structure he refers to is the inverted pyramid style, which is also the main structure used in most print media. Linguistic complexity is defined as deleting connectives and transitions, using short sentences, including information that can be easily visualized but that is irrelevant to the story, arranging paragraphs in descending order of importance and using ambiguous pronoun-antecedent references (Housel, 1984). Story structures following the inverted pyramid style are written so that the most important information, what would be the conclusion of the story, is presented first, followed by the causes or reasons, with the general background information (in a narrative, the introduction) presented last. Proponents of more "scannable" Web pages recommend the inverted pyramid style as the most effective method of writing for the Internet because of its ability to capture the viewer's attention quickly (Nielsen, 1997). Studies of the inverted pyramid style, however, have suggested that it is not highly conducive to accuracy of recall. The inverted pyramid style divides the reader's attention between attempting to decode the meaning of the conclusion and receiving the facts as they are presented

instead of focusing the subject on the content of the report and leading him or her to the conclusion (Lang, 1989; Magliano, Schleich, & Millis, 1998). Studies that convert stories written in the inverted pyramid style to a more logical, narrative presentation of events have shown significant increases in subject comprehension and recall (Berry, 1988; Larsen, 1988).

The last element of story structure is the use of emotionally stimulating information or strong negative or violent images to increase recall for specific events. The majority of studies focusing on this variable have shown that the use of a highly stimulating image—descriptions or pictures of events that elicit strong feelings, whether positive or negative, on the part of the viewer—significantly increase the subject's ability to recall that particular news item (David, 1996; Gunter, Furnham, & Gietson, 1984; Lang, Newhagen, & Reeves, 1996). Researchers have found that the use of these images has a stronger effect on males using a print medium than on females (Gunter, Furnham, & Gietson, 1984). Research has also shown that the use of strong negative images can result in an avoidance reaction on the part of the viewer, as opposed to a highly stimulating positive image, which has been shown to increase viewer receptivity to the message (Lang, Dhillon, & Dong, 1995). One study even suggested that the use of deviant images, or images that do not fit the viewer's expectations (e.g., "man bites dog" as opposed to "dog bites man"), can increase the viewer's recall of the story by causing increased interest in the story and, therefore, increased attention (David, 1996). Both situations increase comprehension and recall because the viewer spends more time thinking about the story as a result of the image.

The final presentation variable to be considered is item order. Several studies have been performed varying the order of items in a newscast, even the order of sentences in the individual stories, to determine the effect such ordering has on the individual's ability to recall specific facts (Booth, 1970-71; Lang, 1989; Findahl & Höijer, 1985; Kirriemuir, 1997; Wicks, 1992). For the most part, these studies have shown that item order has little effect on the individual's memory for specific facts (Klein, 1978). There have been a few studies, however, that have shown increased

recall for items appearing in the first and last positions of a broadcast or in a series of advertisements (Booth, 1970-71; Berry, 1983; Wicks, 1992), and it has been noted that there appears to be more attention paid to items at the top or beginning of Web pages (Kirriemuir, 1997; Nielsen, 1996). These first and last positions have therefore become known as the "favored positions" in the line-up and should be monitored as potentially confounding variables in measuring viewer recall.

**Theory and Hypotheses**

In discussing theories of comprehension and recall, one must begin by differentiating, as several researchers have done, between comprehension, or understanding of a story, and recall, or memory for the items contained therein. The two processes are highly correlated; however, they are two separate cognitive functions (Woodall, Davis, & Sahin, 1983). Recall is the process by which subjects are able to pull up or remember information to which they have been exposed. It involves storage, retrieval and access to input information. Comprehension, or understanding, by contrast, involves an interaction between new information that is being received and information or knowledge that has already been stored (Woodall, Davis, & Sahin, 1983; Findahl & Höijer, 1985). It has been proposed that subjects can remember information that was not understood, and it has been shown that subjects can accurately understand information that is not correctly remembered (Findahl & Höijer, 1985; Woodall, Davis, & Sahin, 1983). As Woodall, Davis and Sahin have pointed out, it is imperative in studies of comprehension and recall that researchers keep the two processes separate and make clear distinctions between measures of comprehension and measures of recall (1983).

Theories of cognitive processing of news are based largely on the levels-of-processing framework of memory developed by Craik and Lockhart. Levels-of-processing draws on the model of the brain as a computer, viewing the human receiver as a processor of information. The

semantic network is made up of information that is encoded as abstract symbols to form a "language" of events (Alterman & Bookman, 1992). Comprehension and memory are functions of the individual's ability to encode and link new information to these symbols and place it in his or her network. Problems in memory are attributed to problems either in storage capacity or processor speed (Craik & Lockhart, 1972). Either the information does not fit into the individual's semantic network, or there is not enough time for the individual to process all of the information being received—an event sometimes referred to as "information overload.'

The brain processes the information encountered and determines whether the new information fits into the individual's network of existing information or experiences. Individuals subconsciously use this network to decide which news stories to focus on, and, in turn, this network determines which stories will make it into the individual's long-term memory (Craik & Lockhart, 1972; Saljo & Cedersund, 1988; Woodall, Davis, & Sahin, 1983). This subconscious selection or addition to the existing network takes place through a process called "knowledge updating" (Larsen, 1988, p. 441). It is this examination of comprehension and recall using the levels-of-processing framework that causes presentation variables and viewer variables to become significant.

Theories of Comprehension and Recall for Cyberstories

The focus of this experiment is Web site design and its effect on comprehension and recall of news stories. As previously mentioned, little research has been done with regard to user interaction with news stories in an on-line environment. The studies that have been documented focus for the most part on elements contributing to usability, for example, bulleted lists, short paragraphs, minimal scrolling, restricted use of animations and avoidance of frames (Nielsen, 1996). These theories of usability are useful in the creation of a valid instrument for measuring comprehension and recall for multimedia sites.

It has been proposed that individuals do not read information on the Internet—they scan (Nielsen, 1997). Emerging trends in Web design, therefore, call for a home page made up of "scannable" headlines with brief abstracts beneath them to allow the reader to quickly decide whether the information interests him or her. Web designers recommend that stories be written in the inverted pyramid style with only one thought per paragraph (Nielsen, 1997). Motion on these pages must be kept to a minimum, and frames should be avoided as they tend to confuse the reader by breaking the cognitive flow of the pages (Nielsen, 1996). These usability models neglect the presentation variables shown to contribute to comprehension and recall in traditional media; and multimedia pages, by virtue of being new, introduce distractions not present in traditional media, which could influence comprehension and recall (DeFleur & Cronin, 1991). While a text-only site would also suffer from this novelty effect, multimedia increases it by presenting new stimuli in a form that has very few semantic links with the subject. These factors could produce lower levels of processing for the information contained in the stories on these sites and, therefore, lower comprehension and recall. The hypotheses tested in this study, therefore, are as follows:

H1: Comprehension will be better for full-text stories appearing on a traditional, print-based (plain) site than for the same stories appearing with audio or video enhancements on a more interactive (multimedia) site.

H2: Recall also will be better for text-only stories on the plain site than for the same stories accompanied by audio and/or video on the multimedia site.

H3: User response in terms of likability and level of interest, by contrast, will be higher for the multimedia site than for the plain site.

**Methodology**

Eighty-four undergraduate students at Louisiana State University participated in this study. Educational differences were controlled for because all subjects were at least sophomores, which

implies that the majority of the students were 19- to 20-year-olds with at least one year of college education. Each subject was assigned to an individual IBM-compatible personal computer with a 17" color monitor, and students assigned to the multimedia sites were provided a set of headphones for use with the audio and video components. Internet connection speed was T1 for all computers to ensure swift connection and to avoid any negative affects of downloading time on attention. Subjects participated during regular class time and were divided into groups of ten to 20 students. Participants from the same class all viewed the same site, and subjects were instructed to examine the stories on the site they had been assigned at a relaxed pace and not to spend excessive time on any particular story. Minimal instructions were given to avoid conditioning subjects to the treatment.

Subjects viewed one of two versions of the same Web site. The Web site consisted of six stories not heavily covered in the media and that were at least six months to a year old. One story was selected from each of the following news categories: local news, national news (politics), international news, sports, health and human interest (people). Stories were selected from the archives of the CNN Interactive Web site, and effort was taken in the selection process to choose moderately interesting stories that were not overly visual or sensational. For example, stories were selected that focused on the war on drugs, school safety and AIDS research while stories on triple homicides, car bombings or animal attacks were avoided. Stories were selected with the intent that they would raise similar degrees of interest without biasing the results for or against any one story (as much as possible, considering individual differences).

The stories selected for use in this study all originally contained audio and/or video accompaniment. On the multimedia site these enhancements appeared in their original format and placement in the story. On the plain site these enhancements were transcribed and placed in the same location in the story as on the multimedia site. Otherwise, the text and images on both sites were identical. This made it possible to determine the influence on comprehension and recall of the

presence or absence of the audio and/or video files. Both Web sites contained a weather box giving current weather information, and both sites contained at least three advertisements. The ads on the plain site appeared as still banners, while the ads on the multimedia site had subtle animation. Both sites were given the generic title *The Crosstown Reporter*, and headline sizes and font styles were the same for both sites.

The plain site consisted of three linked Web pages with two stories per page. The first page contained the local and political stories; page 2 contained the international and health stories; and page 3 consisted of the people and sports stories. All pages had links to the previous and next pages at the tops and bottoms of each page. Layout on the home page consisted of the flag extending across the top of the page with the weather box at the top left corner and a picture of the downtown Baton Rouge area in the top right. Pages 2 and 3 had the flag repeated in miniature at the top left and links to the previous and next pages at the top right. Ads were centered at the bottom of each page, and no ads were placed in or between stories.

There were no additional graphics on the plain site apart from the flag, the pictures and the ads. Stories did not contain bullets or text enhancements such as bold, colored, or italicized text unless italics were necessary for grammatical purposes (e.g., titles of books, movies, plays, etc.). All stories were in black text on white background and were arranged in columns format.

The multimedia version of the site consisted of seven linked Web pages. The home page consisted of six headlines, each with a brief one-sentence abstract beneath it, arranged in two columns of three. Following the abstracts were links to the full stories. The full stories were contained on one page and were linked back to the home page. The flag was identical to the one used on the print-based site, appearing in the top left corner on each linked page along with the category of the story (i.e., local, political, international, health, people or sports). Each page also contained ads exhibiting subtle animation, and ads were centered at the top of each page. The same pictures that appeared on the home page were repeated on the linked pages to illustrate the stories

they accompanied. The home page also contained a weather box with the same information as the weather box appearing on the plain site, but with an animated illustration.

Data Analysis

The dependent variables in this study were comprehension, recall and user response to the site. The independent variable was site design (i.e., presence or absence of multimedia). Factors controlled for were item order, level of current events knowledge and interest. Item order and interest were measured on a self-reporting basis in the post-test, and current events knowledge was measured in the pre-test. To monitor the effects of interest, subjects were asked in the post-test to rank the stories they found most interesting as well as the general areas of news that interest them most. Gender and time of day were asked for in the post-test. To control for possible prior knowledge, subjects were asked in the post-test to indicate whether they had any prior knowledge of any of the stories used in the experiment and if they did, to list those stories by name or topic. Subjects were instructed to attend solely to the news stories presented before viewing the sites, and, in responding to the test questions, they were asked not to guess at the answers. These instructions were intended specifically to reduce error in the results.

Subjects were given a timed current events pre-test consisting of 12 short-answer questions. The pre-test was strictly a measure of prior knowledge and level of media use, and it did not reflect the post-test. Students were allowed five minutes to complete this portion of the test; however, the time limit was not announced to the subjects. After the treatment with the individual sites, subjects were given a two-part post-test. The first part was a 12-question objective test in which subjects were asked to indicate the first and last stories they read, to give individual responses to the design of each Web site, to complete an interest section in which they indicated on a scale of 1 to 5 (with 1 being "most interested") the category of news that interests them most, to indicate which stories they may have already been familiar with, and to indicate their sex and the

time of day the test was taken. Subjects also indicated using the scale mentioned above the stories on the site they found most interesting. This portion of the post-test was quite brief and mainly was used for informational purposes and as a control device.

The second part of the post-test was the measure of comprehension and recall. The questions were structured to measure these two dependent variables separately. Questions measuring recall were mainly identification items phrased as who, what, when and where questions, while the questions measuring comprehension were more interpretive and were phrased as why and how questions. Questions were presented in a 30-item cued-recall test. The cues were the names of specific people, references to locations or events or the mention of particular facts or details that preceded the information sought. These questions differed from free recall because subjects were not asked simply to list as much information as they could remember; rather, they were given specific cues as to the information sought.

Subjects were asked five questions on each story: three recall and two comprehension questions; and answers were scored based on a two-point system that has been used in several previous studies. Completely correct items were assigned two points, partially correct items were assigned one point and answers that were not correct or questions that were not answered were assigned zero points (DeFleur et al., 1992; Gunter, Furnham, & Gietson, 1984). The maximum possible recall score was 36, and the maximum possible comprehension score was 24. This number of questions was selected to give a good measure of comprehension and recall for each story without causing fatigue in the subjects.

**Analysis and Discussion of Findings**

Before conducting the experiments, a pilot study was run in which a small group of graduate students and communications professors participated in the experimental treatment and took the pre- and post-tests. The pilot study highlighted potential difficulties in using the computers

and potential problems in setting up the sites for student use. After the pilot results were examined and the problems solved, the actual tests were conducted.

The first round of tests involved approximately 60 undergraduate journalism students divided into four groups of 14 to 17 students, each presented with one of the Web sites discussed. Experimental results were then subjected to preliminary analysis, and it was found that the number of female subjects outnumbered males two to one in the multimedia setting and three to one in the plain setting. For this reason, another round of experiments was conducted to increase the number of male respondents. In this second round of experiments, all female respondents were discarded and only the male responses were kept. An additional two female subjects were discarded from the text-only setting of the first round as they were observed not participating in the Web site viewing portion of the treatment. After the second round, male to female ratios were equal and the final numbers were 44 participants in the plain site to 40 participants in the multimedia site.

The results from all subjects were combined so that the mean scores could be compared in SPSS for Windows. First, a Pearson correlation analysis was conducted to compare the scores for comprehension, recall, response to site, sex, interest in stories on the site presented, time of day, level of media use and current events knowledge. The results indicated significant correlations between comprehension and recall, between time of day and recall, between level of current events knowledge and time of day, between sex and response to site, between comprehension and response to site and between media use and level of current events knowledge. Comprehension and recall were correlated ($r = .557$; $p < .01$) as would be expected. Time of day was shown to be correlated with recall ($r = .248$; $p < .05$) and current events scores ($r = .275$; $p < .05$), with subjects who tested in the morning scoring higher on both tests than those participating in the afternoon. Total comprehension scores were negatively correlated with response to site ($r = -.236$; $p < .05$); however, as response scores were ranked in descending values (i.e., the lower the score, the higher the response), this actually shows comprehension being improved by a favorable response to the

site. Level of media use and current events scores were correlated ($r = .632$; $p < .01$) as would also be expected, and presence of multimedia was shown to be correlated with favorable response to the site ($r = -.190$). This last correlation, however, was not found to be statistically significant ($p = .084$).

Hypothesis One: Comprehension and Site Design

This hypothesis predicted that comprehension would be greater for stories appearing on the plain, text-only site than for stories appearing on the multimedia site. Comprehension scores as a whole were quite low for both sites, but that finding is consistent with previous research. The average comprehension score for both sites was about 50%. Mean comprehension scores are illustrated in Table 1.

**Table 1: Descriptives of Comprehension**

| Site Design | Mean Score | Total Possible | Percentage | S.D. |
|---|---|---|---|---|
| Plain | 12.5 | 24 | 52% | 5.0 |
| Multimedia | 12.2 | 24 | 50% | 4.2 |

Mean comprehension scores were subjected to the ANOVA test, and it was found that there was no significant difference in comprehension scores for subjects viewing the plain site compared with subjects viewing the multimedia site. This hypothesis, therefore, was not supported as it could not be proven that differences in scores were not caused by factors other than chance. Results of the ANOVA test are shown in Table 2.

**Table 2: ANOVA for Comprehension**

| Model | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Between | 1.061 | 1 | 1.061 | .049 | .825 |
| Within | 1776.975 | 82 | 21.670 | | |
| Total | 1778.036 | 83 | | | |

The plain site was coded as 0, and the multimedia site was coded as 1 for this test. Comprehension scores were then combined and compared based on the influence of the independent variable site design, or "group." In the row for between groups, the variation in

comprehension that can be attributed to site design is not very large. The F ratio was shown to be insignificant (p = .825), and largest variation in scores (Within) is attributable to variables that cannot be accounted for. This suggests that site design had little effect on the subjects' ability to comprehend the information contained therein.

Hypothesis Two: Recall and Site Design

The second hypothesis predicted that recall scores for stories appearing on the plain site would be higher than for the same stories appearing on the multimedia site. As with comprehension, recall scores were also not very high for the subjects in each group, and again, this is consistent with past research. Mean recall scores are illustrated in Table 3.

**Table 3: Descriptives of Recall**

| Site Design | Mean Score | Total Possible | Percentage | S.D. |
|---|---|---|---|---|
| Plain | 16.4 | 36 | 45.5% | 6.0 |
| Multimedia | 16.6 | 36 | 46.1% | 4.9 |

Mean recall scores were also subjected to the ANOVA test, and it was found that although recall scores for the multimedia site were higher than recall scores for the plain site, the difference was not significant. This hypothesis, therefore, was also not supported. Results are shown in Table 4.

**Table 4: ANOVA for Recall**

| Model | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Between | .782 | 1 | .782 | .025 | .874 |
| Within | 2524.170 | 82 | 30.783 | | |
| Total | 2524.952 | 83 | | | |

The variation in recall that can be attributed to site design was again not very large, and the F ratio was shown to be insignificant (p = .874). This suggests that site design had little effect on the subjects' ability to recall the information presented.

It is notable that the standard deviation among scores on the multimedia site was much lower than scores on the plain site for both comprehension and recall. Also notable is that the mean recall score for subjects assigned to the multimedia site is slightly higher than for the plain site, implying that multimedia may slightly improve recall; however, as shown in Table 4, the difference in mean recall scores for the two sites was not significant.

Hypothesis Three: Subject Response and Site Design

The third and final hypothesis predicted that subjects viewing the multimedia site would report a higher, more positive response in terms of likability and level of interest than subjects viewing the plain site. Interest was tested through a Likert scale in which students indicated level of interest in each of the six stories from 1, meaning high interest in the story, down to 5, meaning very little interest in the story. Likability was measured in a similar manner with students ranking the site as either 1: "I would visit this sight regularly" (excellent), 2: "I would visit this site again" (good), 3: "I might visit this site again" (fair), or 4: "I probably would not visit this site again" (poor).

Frequency analysis of likability showed that subjects in the plain group indicated lower response, with 52% giving a 3 or 4 and only 48% giving a 1 or 2 rating, compared to the multimedia site where 65% gave a 1 or 2 and only 35% gave a 3 or 4 rating. Results of the Pearson correlation analysis, however, showed the correlation between site design and likability was not significant ($p > .05$). The ANOVA test was also run for likability scores; results are shown in Table 5.

**Table 5: ANOVA for Likability**

| Model | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Between | 1.691 | 1 | 1.691 | 3.064 | .084 |
| Within | 45.261 | 82 | .552 | | |
| Total | 46.952 | 83 | | | |

Likability scores were compared based on the influence of the independent variable site design, with plain coded as 0 and multimedia coded as 1. The F ratio was high, indicating a relationship between likability and multimedia design; however, this ratio was not shown to be statistically significant ($p = .084$).

Interest rankings for the multimedia site were also more pronounced than for the plain site. The percentage of subjects who fell into the neutral category was much higher for the plain site than for the multimedia site. The percent indications of interest for all stories broken down by site are illustrated in Table 6.

**Table 6: Percent Interest in Stories by Site Design**

| Site | High Interest | Neutral | Low Interest |
|---|---|---|---|
| Plain | 13.6% | 72.9% | 13.5% |
| Multimedia | 22.5% | 52.5% | 25% |

The mean interest score for all stories combined on the plain site was 14.9, and for the multimedia site it was 15.4; however, the lower the score, the higher the interest indicated. Interest in stories on the multimedia site, therefore, was actually shown to be slightly lower. The correlation between total interest and site design was not found to be statistically significant ($p = .506$) as was the case with likability; therefore, this third hypothesis was also not supported.

**Discussion**

The lack of support for the first two hypotheses in this study may be explained by the research on "multiple channels" discussed earlier in the literature review. This research focused on improving recall scores for broadcast news using many different methods of presentation. Examination of the Web sites used in this study shows that the multimedia items were embedded in a text setting, and although in three of the stories the multimedia items did not repeat or paraphrase the text, the enhancements were still closely related to the content of the story and gave additional information on the topic being discussed. The disadvantages of broadcast, therefore,

may have been balanced by the advantages of having a text accompaniment. Also, in this experimental procedure, subjects were directed to attend solely to the information presented, which probably ruled out the "contextual interference" past studies have attributed to lowered recall scores for broadcast media. Although in this study multimedia did not increase comprehension and recall scores above those for the plain site, further study may show that multimedia enhances the user's ability to remember textual information by reinforcing that information following the "multiple channels" approach.

The results of this study present interesting considerations for Web site developers as well as media outlets. While the hypotheses were not supported, it is interesting to note what was suggested. Comprehension and recall appear to be unaffected by the presence or absence of multimedia as does user response to the individual stories and to the Web site as a whole. For the Web developer or media outlet considering the addition of multimedia or currently using multimedia, or even for those who may be concerned about the absence of multimedia in their sites or their inability to produce such enhancements, these findings have several implications.

The first implication is that the use of subtle animations, links and multimedia may not reduce the reader's understanding or ability to recall the information presented. This disagrees with existing research on Web design that has suggested avoiding such visual illustrations. It suggests that organizations need not be concerned that these enhancements will damage the effectiveness of their message, but it also suggests to those smaller organizations that may not be financially or technologically able to use multimedia that their omission will not detract from these organizations' ability to convey an effective message.

The second implication of these results is that the use of animated visuals or high-tech enhancements like audio or video may not increase the viewer's overall response to the Web site. While these findings do not suggest that the use of these enhancements decreases response, it may again give comfort to the smaller organization concerned about its ability to compete effectively in

the Internet community without using advanced technology. It is important to keep in mind, however, that the frequency analysis indicated a higher response to sites that did include multimedia, and while this difference was not shown to be statistically significant, it is possible that a larger study using more subjects might result in a different conclusion.

The third implication, and perhaps the most compelling for Web researchers, is that interest in the content of the Web site may not be significantly affected by multimedia. As discussed in the methodology, stories used in this study were purposely selected based on moderate interest levels. This was done in order to avoid any one story's being significantly interesting over another and to highlight any heightened curiosity and, therefore, increased interest due to the presence of multimedia enhancements. This may have affected likability ratings; however, it should have made the impact of the additional technology on interest more pronounced. What is suggested by the findings is that a moderately interesting story is still considered only moderately interesting whether it is technologically enhanced or not. The Web developer or media outlet that may consider using multimedia to increase the interest level for a particular story or for the content of a Web site may find that practice unsuccessful. By contrast, the smaller media organization that may have a particularly compelling message and that may be concerned it will not be noticed due to its plain appearance, may find their fears to be unfounded.

It is again proper to point out that frequencies indicated more neutral responses to the plain site than for the multimedia site; however, the mean scores, though not statistically significant, showed interest indicated at a higher frequency for stories on the plain site than on the multimedia site. Larger studies, however, using more subjects and subjects more representative of the general population may lead to different conclusions.

Problems with the Study

As with most experimental studies, this study suffers from a lack of external validity, meaning the results cannot be generalized to real-life situations. For example, in real-life situations, individuals are rarely required or even motivated to read every story on a Web site in a set amount of time without being allowed to follow links to other sites or engage in other activities. This study also suffers from the college sophomore problem, or the problem that "a rather large proportion of research findings . . . come from studies of white rats and college students" (Myers & Hansen, p. 374). This is due to the difficulty of securing more representative subjects that are not committed to other responsibilities, which, of course, take priority over participation in experimental research. This problem can also be attributed to the financial constraints facing the typical graduate researcher.

The most that can be hoped for in any experimental research is an indication of causal relationships among variables. In the case of this study, there was also the problem of subjects not being extrinsically motivated to participate. The students used in this study were required to appear in class; however, once the experiment was announced, they were told by their instructors that their performance was not related to their grade in the class. Analysis of scores often showed subjects who skipped large portions, failed to answer any questions, or provided silly responses (e.g., "Monica Lewinsky" as the principal of Belen High School, etc.). While such findings cause considerable frustration on the part of the researcher, they suggest that the use of motivation techniques, such as the offer of money, extra credit or some other type of reward may have an impact on the results of future studies on this topic.

A concern going into the study was number of news items used and the effect this would have on comprehension and recall scores. While the use of six news stories is consistent with past research (Bennett, Swenson, & Wilkinson, 1992; Brosius, Donsbach, & Birk, 1996; Lang, Newhagen, & Reeves, 1996; Sundar, 1998), and the rationale behind having one story

representing each area of news was to account for individual differences in interest, it is possible that the use of fewer stories and more test questions would have yielded different results. A few past studies have been conducted in which subjects were presented with only one to four news items and then evaluated using longer post-tests (Gunter, Furnham, & Gietson, 1984; DeFleur et al., 1992; DeFleur & Cronin, 1991; Wicks, 1992). Future studies on this topic may consider this option when constructing the test sites and evaluation measures.

Finally, it was discovered after the treatment that two of the four questions testing response to site were double-barreled, and, therefore, the results of these questions could not be used in the analysis. Future study would require the omission or restructuring of such items to allow increased precision in measuring this dependent variable.

**Additional Findings and Suggestions for Future Research**

This study briefly examined several other factors in addition to the proposed hypotheses. Questions on the pre- and post-tests gathered data on such influences as time of day, style of writing, interest, sex of the subject, stories read first and last, and number of advertisements remembered from each site. Given below are short discussions of the responses to these questions and suggestions for future research.

Time of Day

Time of day and recall were found to be significantly correlated ($r = .248$; $p < .05$). This is consistent with existing research that has shown recall levels to be higher in the morning and lower in the afternoon (Gunter, Jarrett, & Furnham, 1983). The eight classes used in the study were equally distributed, with two plain groups and two multimedia groups tested before noon and two plain groups and two multimedia groups tested after noon to control for this variable. Time of day was also significantly correlated with current events scores, with subjects who participated in the

morning scoring higher on the current events pre-test than their peers in the afternoon ($r = .275$; $p < .05$). This suggests that information obtained a day or even a week before was recalled at a significantly higher level in the morning than in the afternoon. Level of media use was significantly correlated with current events knowledge ($r = .632$; $p < .01$), meaning subjects who indicated a high level of media use (one or more times a day by either watching, reading or listening to the news) performed better than their low-use counterparts on the current events pre-test.

Gender

Analysis further indicated that sex and response to site were significantly correlated ($r = .223$; $p < .05$). Males, according to this study, were more likely to give the site a low rating than were females. The reasons for this finding are not clear, but it may suggest that females are more reluctant to give a low rating than males. It could also suggest that females are more responsive to multimedia than males. Mean comprehension and recall scores for both sites combined were higher for females than for males–a finding that is consistent with past research on interest and increased comprehension and recall. The mean comprehension score for females was 13.1 (55%) compared with 11.7 (49%) for males, and the mean recall score for females was 17.1 (48%) compared with 16.0 (44%) for males. Future researchers may want to examine the response by gender to multimedia or to Web news in general, the differences in male and female rating patterns, or the content of stories selected for use in a particular site and its relation to male and female likability rankings.

Abstract v. Concrete Information

Redundancy in audio and video accompaniment and whether the information contained in the story was abstract or concrete was also noted for each story. Redundancy was determined by whether or not the information presented in the audio or video clip repeated or paraphrased the

same information given in text. Stories were classified as abstract if the majority of the information in the story focused on the causes and consequences of an event and if the information was considered difficult to visualize. Comparisons of these factors and mean recall scores for each of the stories used on the multimedia site are illustrated in Table 7.

**Table 7: Mean Scores by Story—Multimedia**

| Story | Redundant | Abstract | Mean Recall | S.D. | Mean Comp. | S.D. |
|---|---|---|---|---|---|---|
| Local | yes | no | 2.38 | 1.79 | 2.38 | 1.50 |
| National | yes | yes | 1.98 | 1.46 | 1.28 | 1.11 |
| International | yes | yes | 1.45 | 1.26 | 1.58 | 1.47 |
| Health | no | yes | 4.53 | 1.18 | 2.25 | 1.24 |
| Sports | no | yes | 3.88 | 1.52 | 2.70 | 1.32 |
| People | no | no | 2.43 | 1.20 | 2.10 | 1.01 |

Simply looking at the descriptive statistics indicates that stories containing highly redundant audio or video accompaniment had lower mean recall and comprehension scores than stories containing unique audio or video. This is not consistent with the research and perhaps warrants further study. Also, stories containing abstract information appeared to have little effect on comprehension or recall scores. This is also not consistent with the research and perhaps warrants further investigation.

Interest

The health and sports stories had the highest recall and comprehension scores and were also indicated as the most interesting stories on the Web site by students in both groups. This finding is consistent with research suggesting higher interest will lead to higher comprehension and recall. Also notable is that when indicating general news interest, more subjects listed sports and national news as the news categories of highest general interest; however, while the mean sports scores were high, comprehension and recall scores for the national story were lowest and second lowest of all scores respectively. This tends to support the proposal by Berry (1988) that

interest aroused by the way a story is presented is a stronger predictor of recall than prior interest in a general news category.

Item Order

Item order was noted by having each subject indicate the stories read first and last on the Web site. It was interesting that the national story was the first story read on both Web sites by the majority of subjects (98% for plain; 93% for multimedia). The stories read last by site were the sports (84%), people (11%) and health (5%) stories on the plain site; and the people (75%), sports (23%) and international (2%) stories on the multimedia site. This order was to be expected on the plain site as the national story was the first full-text story presented and the sports story was the last, and subjects would have had to do considerable scrolling and navigation to read the stories in a different order. This was surprising, however, on the multimedia site where subjects were presented headlines and abstracts of all six stories and were allowed to choose which story to read first based on this information. On the main page for the multimedia site, the information about the national story was placed in the top left position and the people story was at bottom right, which may suggest that Web readers still follow the traditional reading pattern of left to right, top to bottom in spite of being given a choice. This behavior may also have been the result of the instruction to read all stories, and had subjects been given the option, they may have chosen instead to read only one or two of the stories and in a different order. Still, as mentioned previously, recall scores for the national story were lowest of all, indicating the "favored" first and last positions may have little influence on recall of Web news, and though mean recall scores were higher for the sports story, this may have been more a function of interest than position on the Web page.

Advertisements

Recall of advertisements by site was added to the post-test as a result of post-pilot interviews. It was added as a self-reporting item in which subjects listed by product name or slogan all the ads they could remember from the site they viewed. Simple frequency analysis found higher ad recall among subjects viewing the plain site than subjects viewing the multimedia site. Nineteen of the 44 subjects assigned to the plain site remembered at least one ad, with two remembering all three, compared to six subjects remembering only one of the six ads from the multimedia site. Reasons for these results are unclear, but a possible cause for the lowered recall of ads on the multimedia site could be the presence of competing visual stimuli represented by the audio and video files. It could mean that stories containing audio or video enhancements are better at holding the user's attention. It could also mean advertisers should rethink their placement of banners on pages containing multimedia enhancements. This is an interesting finding, and one that should be researched further.

Subject Computer Knowledge

An unexpected observation was the number of participants with low computer skills. In each group, subjects were given step-by-step instructions on opening the Web browser, following links to the stories and even operating the multimedia files; however, in each group several students still required individual assistance, and it was observed that a few participants in the plain group only read two stories because of apparent unfamiliarity with operating hyperlinks. This was interesting in light of the popular perception of young people as having the highest rates of computer literacy. While this may still be true, it was surprising the number of computer novices at the college sophomore level. Scores for participants who were not observed finishing the Web sites were not included in the analysis.

Multimedia and Response to Site

Response to site and use of multimedia showed a positive correlation that was not found to be statistically significant when subjected to more stringent analysis. Future research involving more subjects and more representative samples may suggest a significant correlation between audio and video enhancements and likability for a particular site. The same is true for the relation between use of multimedia and interest in the content of a Web site. One male subject reported in a post-experimental interview that he would probably not read a text-only story unless he was especially interested in the content. He said he would be more inclined to read a story containing multimedia; however, he indicated that time was a major factor in this decision rather than increased interest in multimedia over text. This is an issue worth exploring and one that might be useful to investigate for future Web developers.

In other post-experimental interviews, several subjects from the multimedia group stated that hearing a quote was more believable to them than simply reading one. The reason given was a belief that it is easier to alter text than audio or video, in which subjects felt tampering would be more noticeable. Studies have been conducted on similar phenomena, most notably by Sundar on source attribution and increased credibility ratings for Web stories (1998). The views communicated by these students, however, indicated a slightly different angle of research and highlighted possible considerations in the decision to use additional audio or video in addition to text in reporting the news. Future research into accuracy and reliability of Web news may consider this credibility issue.

Finally, replication of this study is recommended to verify these results, or perhaps find information that may lead to different conclusions. Replication would ideally incorporate larger numbers of subjects who are more representative of the general population, and future study on this topic should consider the use of fewer news stories and more post-test items. The combination of text and video could function in the same manner as the combination of text and pictures, and

text incorporating illustrative and somewhat redundant audio and video might lead to higher recall, as was suggested by research in broadcast media (Brosius, Donsbach, & Birk 1996). In any event, the combination of multimedia and text is a new and exciting method of news presentation about which the body of knowledge is very small. Future research into this new arena can only serve to increase knowledge and chart new paths through this relatively unexplored territory of message delivery.

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